



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : D04B 1/14	A1	(11) International Publication Number: WO 99/47738 (43) International Publication Date: 23 September 1999 (23.09.99)
<p>(21) International Application Number: PCT/EP99/01765</p> <p>(22) International Filing Date: 15 March 1999 (15.03.99)</p> <p>(30) Priority Data: 09800212 18 March 1998 (18.03.98) BE</p> <p>(71) Applicant (for all designated States except US): N.V. BEKAERT S.A. [BE/BE]; Bekaertstraat 2, B-8550 Zwevegem (BE).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): HEIRBAUT, Guido [BE/BE]; Hoogkamerstraat 288, B-9140 Ternse (BE). VAN STEENLANDT, Wim [BE/BE]; Nachtegalenlaan 10, B-9100 Sint-Niklaas (BE).</p> <p>(74) Agents: MESSELY, Marc et al.; N.V. BEKAERT S.A., Bekaertstraat 2, B-8550 Zwevegem (BE).</p>	<p>(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i></p>	
<p>(54) Title: HETEROGENEOUS KNITTED FABRIC COMPRISING METAL FIBERS</p>		
<p>(57) Abstract</p> <p>The heterogeneous knitted fabric comprises metal fibres and other fibres. The fabric has a single knitted layer structure in which yarns with a high metal fibre content are situated towards one surface and yarns with a low metal fibre content are situated towards the other surface.</p>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakhstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

HETEROGENEOUS KNITTED FABRIC COMPRISING METAL FIBRES

5 The present invention relates to a relatively thin, heterogeneous knitted fabric comprising metal fibres and other fibres in which, more specifically, the yarn composition of the zone bordering its one surface differs from that bordering its other surface. Provided that the other fibres can also resist extreme temperatures, the knitted fabrics can be used for applications in very cold or in very
10 hot environments.

Custom-made heterogeneous knitted fabrics comprising metal fibre yarns are already known from the applicant's patent WO 94/01373. The knitting pattern may hereby differ in predetermined zones over
15 their surface, and/or through the thickness of the cloth. Patent WO 94/01372 also describes the application of this sort of heterogeneous fabric as separation cloth in the moulding of plate glass at high temperature. There is also an ever-increasing demand, in such production and in other applications, for relatively
20 thin heterogeneous knitted fabrics comprising metal fibres that combine a relatively high air permeability with some measure of insulating capacity. The weight of such fabrics will preferably be kept to a minimum, despite the necessary proportion of contained metal fibres.

25 The heterogeneous knitted fabric comprising metal fibre according to the present invention attempts to meet this requirement by providing a plain flat knitted structure in which yarns having a high metal fibre content are present near the one surface, while yarns
30 having a low metal fibre content are present near the other. The expression "high metal fibre content" is here to be understood to

mean at least 30 % metal fibres by volume, preferably more than 40 % by volume, and even yarns consisting of 100 % metal fibre. "Low metal fibre content" is here to be understood to mean less than 12 % metal fibre by volume and, preferably, less than 7 % by volume. The low-content yarn may even consist 100% of other fibres. These may be carbon, glass, basalt, ceramic or synthetic fibres. The knitted fabric generally weighs less than 2 000 g/m² and, preferably, will be of a weight of less than 1 500 g/m².

10 In order to procure the best possible fabric density (air permeability), the yarns bordering one surface, and those bordering the other surface (see overleaf) will preferably be oriented in parallel - according to the same knitting pattern - and be contiguous with each other. They behave, so to speak, as twin yarns, and can be
15 plain flat knitted, with a flattening technique, as weft thread on a circular knitting machine or on a flat knitting machine.

The machine separation can, depending amongst other things on yarn thickness, be optionally between 5 and 30 for round knitting and between 5 and 20 for flat knitting. The yarns having a high and
20 those having a low metal fibre content are thus simultaneously drawn in for knitting towards the same needle, each placed under sufficient tension to form a flat-knit fabric (single stitch layer) in which one of the yarns always passes in front of the other. The yarns with a low metal fibre content are usually smoother than
25 those with a high metal fibre content.

This facilitates the flat knitting operation.

The yarns with a high metal fibre content are, preferably, staple fibre yarns in which the metal fibres, for example stainless steel
30 fibres, have a diameter of between 4 µm and 50 µm. The yarns on the opposite side of the cloth may be filament yarns of 100% glass,

basalt or carbon or synthetic filaments with a diameter below 40 μm . Suitable synthetic filaments include polyaramid or polyimide filaments (Kevlar (R)), brand name of du Pont de Nemours, Twaron (R), brand name of AKZO/ENKA). Spun yarns, whether or not
5 twisted yarn consisting of one or more sorts of fibre, are equally suitable.

During the flat knitting process, one type of yarn (with high metal fibre content) can be used as well as another (with little or no metal
10 fibres) so as to produce a fabric with zones presenting knitting patterns over its surface with differing weight per m^2 , density (air permeability), stretchability or electrical conductivity. The fabric may also contain a fine interlining yarn, e.g., to reinforce the fabric as described in the applicant's Belgian patent application 97/00614.
15 Finally, a single layer fabric zone as described above can be incorporated locally within a surrounding - e.g. double layer - knitted structure on a flat knitting machine. This then produces a knitted fabric containing the relatively thin heterogeneous knitted fabric over part of its surface. The cloth is thus heterogeneous
20 through its thickness as well as over its surface.

EXAMPLE

By way of example, one embodiment of the knitted fabric according
25 to the present invention and its application as a separation cloth in the compression moulding of plate glass will now be explained in further detail. The invention is not, however, limited to this or to analogous embodiments. The cloth was fabricated at a pitch of 12 gauges on a Stoll CMS 440 flat knitting machine to a single
30 Jersey structure without thin interlining stiffening yarn. After removal of all brightening agents from the cloth, the cloth thickness was

approximately 1 mm. The cloth counted 62.5 stitches per cm² and had a weight of 980 g/m². This cloth displayed an air permeability (l/h/10 cm²) of 4164 and was therefore suitable as lining for the male section of the compression mould. The glass fibre surface of the cloth was in contact with the mould, the metal fibre outer surface thus forming the contact with the glass plate during moulding.

In this separation cloth, the spun (staple fibre) high metal-fibre-content yarns consisted of 100% Bekinox type AISI 316 L fibres with a diameter of 12 µm and measuring 133 tex. The low metal-fibre-content yarn consisted of a 100 % glass filament yarn measuring 136 tex.

If a heterogeneous knitted fabric according to the present invention forms a burner membrane for gas burners, coarse yarns are used. Separation on the knitting machine can be set at, e.g., 5. A 100 % metal filament yarn as described in the applicant's patent WO 97/04152 is fitted at the gas outlet side (burner face) of the membrane.

The layer fitted at the gas supply side of the cloth may be, e.g., 100 % glass yarn or ceramic yarn.

The heterogeneous knitted fabric according to the present invention can also be used as a heat shield against oven heat or as electromagnetic shielding cloth. Polishing cloth can also be fabricated according to the invention, with abrasion-resistant metal fibre yarns on the polishing side. It is further possible to imbed the heterogeneous knitted fabric in a plastic matrix. The proportion of other fibres will then preferably comprise synthetic fibres capable of combining with the plastic of the mould.

CLAIMS

1. Heterogeneous knitted fabric comprising metal fibres and other fibres, characterized in having a single knitted layer structure in which yarns with a high metal fibre content are situated towards one surface and yarns with a low metal fibre content are situated towards the other surface.
2. Circular knitted weft thread according to Claim 1, with machine separation between 5 and 30.
3. Flat knitted weft thread according to Claim 1, with machine separation between 5 and 20.
4. Knitted fabric according to Claim 1, weighing less than 1 500 g/m².
5. Knitted fabric according to Claim 1, whereby the other fibres are glass fibres.
6. Knitted fabric according to Claim 1, whereby the other fibres are basalt fibres.
7. Knitted fabric according to Claim 1, whereby the other fibres are synthetic fibres.
8. Knitted fabric according to Claim 1 incorporating a fine multifilament liner yarn.
9. Knitted fabric according to Claim 1, which presents a heterogeneous knitted fabric over its surface.

10. Application of knitted fabric according to Claim 3 as separation cloth for the moulding of glass for vehicle windows.
- 5 11. Application of knitted fabric according to Claim 3 as burner membrane for gas burners.
- 10 12. Application of knitted fabric according to Claim 3 as heat shield.
13. Application of knitted fabric according to Claim 1 as electrically conductive cloth.
- 15 14. Application of knitted fabric according to Claim 1 as electromagnetic shielding cloth.

INTERNATIONAL SEARCH REPORT

National Application No

PCT/EP 99/01765

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 6 D04B1/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 D04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 44 01 417 A (AKZO N.V.) 28 July 1994 (1994-07-28) column 6, line 40 - line 59; claims 1,3,7 ---	1,4,5,7, 9
A	WO 97 04152 A (N.V. BEKAERT S.A.) 6 February 1997 (1997-02-06) page 5, line 29 - page 6, line 10 ---	1,3,4,11
A	WO 94 01373 A (N.V. BEKAERT S.A.) 20 January 1994 (1994-01-20) cited in the application ---	
A	US 3 806 959 A (GROSS) 30 April 1974 (1974-04-30) -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

15 July 1999

Date of mailing of the international search report

22/07/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
 NL - 2280 HV Rijswijk
 Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
 Fax: (+31-70) 340-3016

Authorized officer

Van Gelder, P

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/EP 99/01765

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 4401417 A	28-07-1994	NONE	
WO 9704152 A	06-02-1997	BE 1009485 A CN 1191001 A EP 0839221 A	01-04-1997 19-08-1998 06-05-1998
WO 9401373 A	20-01-1994	BE 1006069 A AU 4301893 A	03-05-1994 31-01-1994
US 3806959 A	30-04-1974	NONE	